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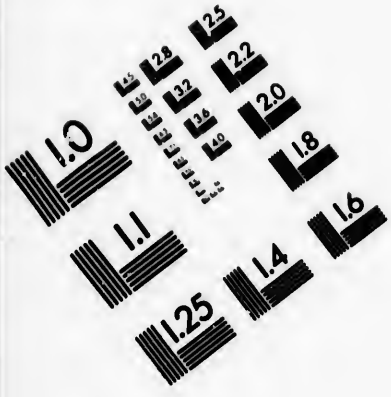

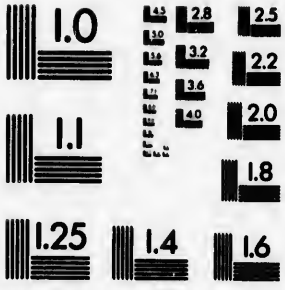

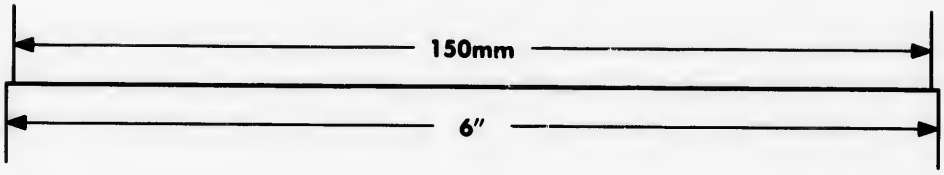

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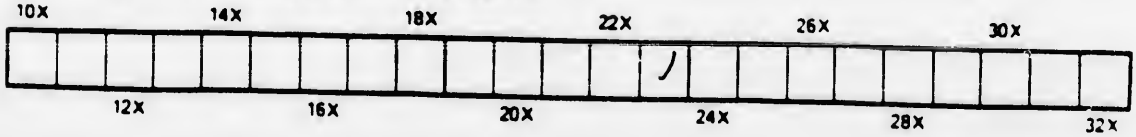

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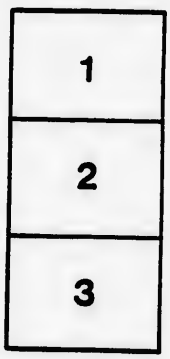

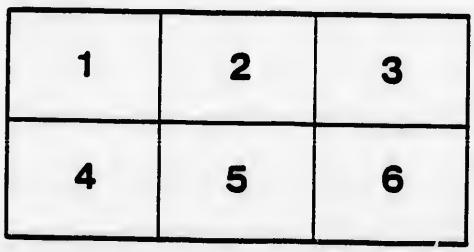

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1892

EVIDENCE

OF

MR JAMES FLETCHER

ENTOMOLOGIST AND BOTANIST

BEFORE THE

SELECT STANDING COMMITTEE OF THE HOUSE OF COMMON

ON

AGRICULTURE AND COLONIZATION

SESSION OF 1892

(PRINTED BY ORDER OF PARLIAMENT)

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COMMITTEE ROOM 46, HOUSE OF COMMONS,

WEDNESDAY, 13th April, 1892.

The Committee on Agriculture and Colonization met at 10 o'clock, Dr. Sproule, M.P., in the chair.

The CHAIRMAN: Mr. Fletcher, the Entomologist and Botanist of the Experimental Farms, is with us this morning. I think we had better continue the course we have hitherto followed, and allow Mr. Fletcher to deliver his address, and afterwards any hon. member can ask any question he may desire

Mr. FLETCHER: Mr. Chairman and Gentlemen,—I have now had the pleasure and honour of appearing before this Committee on several occasions, but there are some members of the Committee who may not be familiar with the work that I am intrusted with at the Experimental Farm. It is the study of insects and plants. The importance of these different branches of work is not yet thoroughly appreciated by farmers, but I find that they only require to be brought to their notice to convince them of their value. The different methods of publication in reports and bulletins from the Experimental Farm give us opportunities of bringing before the public such parts of the work as have been completed, and also of making suggestions which may be of use to agriculturists throughout the country.

ECONOMIC VALUE AND PROGRESS OF ENTOMOLOGICAL SCIENCE.

The newspaper press has also very materially assisted in this work by giving publicity to many minor experiments on matters which required immediate attention and upon which it is not advisable or possible to publish official documents. My own thanks are particularly due to the agricultural press, especially to the *Farmer's Advocate*, of London, the *Nor'-West Farmer*, our own local papers here, the *Weekly Mail*, of Toronto, and the *Prince Edward Island Farmer*. I mention these as papers which have been of use to me in my department, not by comparison with any other papers at all. They have applied for information concerning injurious insects, fungous diseases, or weeds, and have made it public when it was furnished them. In the North-west also there are some newspapers which have on different occasions made use of the department as a source of useful knowledge and have published the information so obtained for the good of the farmers in their circulation. These inquiries have been for the most part concerning insects, and, as I explained last

year, I consider the work of entomology in which I am engaged is second to none in importance, to all branches of agriculture.

The study of economic entomology—that is, that branch of the science which deals particularly with the discovery of remedies for injuries caused by insects—has been developed during the last decade phenomenally. It may almost be said to have during that time become a new study. That its value is now generally recognized by farmers is apparent from the fact that last year over 2,000 letters were written from my branch to farmers throughout the country who had applied for information. This recognition of the value of these studies I believe is to be due to the fact that the information given has been found useful.

I am, therefore, particularly pleased to have the opportunity of again appearing before this Committee, composed of members of Parliament coming from different parts of the Dominion, so that, if possible, I may gain their confidence and sympathy, and convince them that the work is of value. They will then, should an outbreak of injurious insects or fungous disease occur, be enabled to give their constituents advice to apply for any information they may require at the Central Experimental Farm, or at a similar institution where these studies are being carried on. It very frequently happens that large percentages of any given crop are destroyed by fungous diseases or insect enemies, and frequently, instead of seeking help, farmers give up in despair, as they do very often in the case of thistles, or "quack grass." "There is no use in trying to get it out," they say, "it simply cannot be done." This is not at all the case, and it is to-day just as absurd as to say that insect enemies cannot be treated. There is not one of the more important fungous or insect enemies, concerning which useful advice cannot be given, which will at any rate give the applicant means to mitigate or reduce very materially the amount of injury that is being done; this being the case, it is indeed most valuable advice to the farmers of any district to tell them where they can get this useful information, and induce them to apply for it. The work carried on at the Experimental Farm in these two branches is, I believe, so important, that it is worth while any member remembering this fact, and bringing it before his constituents whenever the opportunity occurs.

I shall, this morning, Mr. Chairman, in the time at my disposal, lay before you a few facts concerning the lines of work that have been carried on during the past year, and also, perhaps, shall allude to some of the experiments which I hope to carry out during the coming season.

RELIABLE REMEDIES AGAINST INSECT PESTS.

I spoke of the great advance that had taken place in the study of economic entomology during the last five or ten years. This advance is due to the increased number of workers engaged in the study, but particularly to two discoveries of new remedies and the best way to apply them for different kinds of insects. I will allude to one or two of these discoveries. Amongst the most important of them is the spraying of arsenites, that is, with chemical compounds containing arsenic such as Paris green for foliage-eating insects, and kerosene emulsion for such insects as live by suction. This latter is an emulsion made of soap-suds and coal oil. Pure coal oil or kerosene is injurious to vegetation; therefore, before it can be sprayed on vegetation it must be diluted; but coal oil, being so like an oil in nature, will not mix with water. Soap-suds, however, will mix with the coal oil and also with water; therefore, this emulsion, when diluted, can be used upon vegetation without doing the same injury that pure kerosene would. This is a very valuable discovery for many forms, as the scale insects, which could not be injured by the usual methods, can now be easily destroyed.

Another remedy for these insects, which we have not tried in Canada so far, but which is very successfully used in California, is known as the "gas" treatment. This is a method by which the tree to be treated is inclosed in a tent and then the whole tree is subjected to the fumes of hydrocyanic acid. There is no doubt that, but for the discovery of these methods of treating scale insects and the insecticides, kerosene

emulsion, gas, rosin, &c., the cultivation of all *citrus* fruits, such as oranges and lemons, would to-day be quite impossible, both in Florida and California.

PROPER METHODS FOR APPLICATION OF REMEDIES.

Another discovery of great importance in this study was the invention of a proper nozzle. There is, perhaps, nothing that leads so much to failure in the treatment of injurious insects as improper nozzles, and the improper use of the name Cyclone Nozzle. The latter is a small instrument invented at Washington under the direction of the United States Entomologist, and has the special feature that the fluid is forced into it in such a manner that it strikes the opposite side with force, and, being driven through a very small central orifice, it does absolutely break up into a spray. There are several nozzles in the market, but, unlike the Cyclone Nozzle, many of them have not the effect of reducing the liquid into perfect spray. The necessity of having the liquid thus finely divided is, that not only is less injury done to vegetation by a corrosive poison, as it is spread in smaller particles over the plants, but a small quantity is spread over a much larger area, and there is, therefore, a very great reduction in the cost of the materials used. Very frequently much more of a poisonous substance than is necessary for the work to be done is placed upon the plants treated. The very minutest particle is all that is necessary, and the spray has to be a very fine mist, just sufficient to destroy the insects, but not enough to hurt the plants. Many of the substances used are corrosive and injurious to any plant to which they are applied, unless they are carefully handled. Paris green is a material of this nature. If it is too strong, it burns the plant upon which it is used. It is, therefore, necessary to apply it in a definite manner and of the proper strength, which must be ascertained by experiment for each kind of plant; and therefore, in giving instructions, it is necessary to give these in a definite manner too. Nothing, perhaps, has done more harm in the treatment of cultivated crops for injurious insects than the "rule of thumb" measure, so often recommended, "a spoonfull." Everybody knows that spoons vary in size. There are table spoons, desert spoons, teaspoons, and so on; and besides this, these kinds all vary in size also, so that you can easily get one teaspoon which would hold twice as much as another one, and you might thus get double the quantity you required for certain plants. No mixture should be used with such an indefinite measure as a spoonful; every ingredient should be measured by weight. Those who try these remedies are liable to do more harm than good, even when they carry out strictly the instructions given by those who recommend remedies in such a foolish manner. The true Cyclone Nozzle or Riley Nozzle is made at Washington. A very important modification of the Cyclone Nozzle was made by a Frenchman named Vermorel, by the addition of a little needle which is forced through the orifice by means of a spring attached to the handle of the instrument. Any small obstruction which may have stopped up the orifice of the nozzle is easily removed by simply pressing the spring. This, to one who is used to working with spray nozzles, will at once be recognized as a very great advantage, for there is nothing so annoying, when you have got all your apparatus ready and in working order, as to have to stop, take it down, unscrew the nozzle to clean it out, and set to work again. Although so small, and producing such a fine spray, the use of these nozzles is applicable to even large trees. By mounting this very small nozzle—which in some forms does not measure more than half an inch in diameter across the front, and in which the orifice is only a tiny pin-hole in the middle—on a very light rubber tube, such as is used here for the gas pipe, and attaching that to a light pole, such as a bamboo fishing rod—you can raise it to any height you require in practical work. You can spray very easily all over trees thirty or even forty and fifty feet high, by tying a small tube to a light pole in the way described, and by that means raising the nozzle to the required height. The liquid having been reduced to a very fine spray, does not go very far from the nozzle. It is therefore necessary to spray the trees on the side from which the wind blows, and it will be sometimes necessary to go through an orchard and spray the trees twice, so as to get them thoroughly sprayed.

These discoveries and inventions to which I have briefly referred, have been mostly made within the last few years, and it is not too much to say that it is now perfectly possible to wage war successfully against nearly all the leaf-eating insects which attack crops. These are very many, both in numbers and kinds, but the intelligent fruit-grower now recognizes that these very injurious insects which destroy so many of our crops are a blessing in disguise, for not only do they injure the crops and the trees of the negligent farmers most; but considering the small amount of labour he expends in treating them, he sees that he gets very large returns for his time and money. The improvements in labour-saving machinery are now advancing rapidly in all lines, and this is simply a recognition of the importance of machinery in a special line of agriculture which, up to the present time, has hardly been recognized as agriculture at all. The use of insecticides is now so necessary that it may be said, without exaggeration, it is just as necessary as the cultivation and the manuring of crops; because, with the gradual increase of the area under cultivation of any given crop, the insects which prey upon that crop have gradually increased, until now we must take special cognizance of their presence, and adopt measures to combat them.

INJURIOUS INSECTS OF THE SEASON.

I will now refer to some of the different insects which have required attention during the past year. Orchard pests of several kinds were abundant. The most important was one known as the "Eye-spotted Bud-moth," a small insect not expanding much more than half an inch across the wings. A small fact, which has been learned during the past season concerning this insect, well illustrates the value of knowing the life-history of an injurious insect, so as to learn the most practical remedy. If you know the way and seasons when an insect passes through its different stages, you then have some means of finding out its most vulnerable point.

The Eye-spotted Bud-moth passes the winter upon the twigs of fruit trees as a half-grown caterpillar. There is only one brood in the year, of which the eggs are laid in June. These hatch soon after, and produce small brown caterpillars, which, during the remainder of the year, feed on the leaves of apple and other trees beneath a silken covering, growing very slowly, the size not exceeding one-quarter inch in length. About October they leave the leaves, and spin small silken cocoons or winter shelters upon the twigs. In these shelters they remain all winter; but come forth in the early spring and attack the buds, and seem to prefer those which contain flower buds. They also frequently bore down the centre of the twigs and destroy them, so that whole clusters of blossoms are destroyed at once. When that is done they go to another twig, so that one small insect can do a great deal of harm.

FALSE IMPRESSIONS CORRECTED.

There has been a mistaken idea up to the present time, by which it was supposed that these insects fell from the trees with the leaves and passed the winter beneath the trees. This being the supposed life-history, great pains were taken by fruit-growers to collect all the dead leaves and burn them. That we now know was all wasted labour, because the larvæ had left the leaves before they fell. What is now suggested is to spray the trees very early indeed in the spring, before the flowers open, with Paris green or some other arsenical mixture.

The next insect of which I will speak is the Canker Worm, which, although not generally abundant in Canada, has for some years destroyed, in the Maritime Provinces, a large proportion of the fruit which might have been grown there, simply because, when it increases largely in numbers, as it did there, it frequently strips the trees entirely of their leaves and the fruit cannot mature. During last season a very interesting outbreak of this same insect occurred in Winnipeg, where it was reported to have destroyed several shade trees, by stripping them entirely of their leaves. The trees grown there as shade trees, are the ash-leaved maple, or the

Manitoba maple, as it is sometimes called (*Acer Negundo*). It appears this tree is very susceptible to injury if its leaves are destroyed.

Mr. Fonseca, of Winnipeg, wrote to me that many of the best shade trees in the part of that city where he lives had been destroyed by this insect. Now there are very few insects which can be so easily destroyed, and at so small expenditure, $12 or $15 for a spraying pump, and perhaps two or three dollars more for labour, and the materials used would entirely free the shade trees in the streets of Winnipeg of this troublesome enemy. I think it will be a great pity if the city authorities do not take steps this spring, when the young caterpillars hatch, to have them all destroyed, by spraying the trees with Paris green in water. One pound to 300 gallons of water would be sufficient, and it is of importance, because the trees are so few there.

In Vancouver Island two years ago the oak trees all around Victoria were stripped by another caterpillar of the same family. These caterpillars are known, from their manner of walking, as geometers or loopers. They stripped the tree entirely of every vestige of foliage. These also could have been destroyed just as easily as those I have spoken of above.

The Canker Worm attacks many kinds of trees, but it is particularly injurious to apple trees. Along the Montreal road, near Ottawa, during the past season it occurred in such large numbers in some orchards that many of the trees appeared, as is often stated, as if they had been burned over with fire. With the Canker Worms were also found two kinds of Leaf-rollers, and the caterpillar of the Eye-spotted Bud-moth. These caterpillars are hidden from sight. They roll up or gather together one or more of the leaves of an apple tree and then feed from within on the leaves, so enclosed. The same poison, Paris green, destroys them all. An interesting and new attack, studied last season, was that of a *coleophora* or Case-bearer, so called from the little cigar-shaped case which it carries about with it, and inside which it lives whilst in the caterpillar state. It makes a small hole through the surface of the leaf and eats out the green cellular matter between the surfaces. It has proved rather difficult to fight because of this habit; but after extensive experiment it was found that it could be most successfully combatted by throwing a Paris green spray on the foliage. This insect also passes the winter, half-grown, upon the branches of the infested trees. This fact led me to try spraying trees during the winter with kerosene emulsion, to see if the larvæ could not be destroyed inside their cases in a wholesale manner.

Dr. D. Young, of Adolphustown, Ont., has carried out very careful experiments in this line during the past winter; but on the whole the results have not been satisfactory. Some of the larvæ were killed; but many others, as well as larvæ of the Eye-spotted Bud-moth, were found on the twigs three weeks afterwards uninjured, although the twigs had a strong odour of the coal oil still perceptible upon them. This immunity from injury was of course largely due to their being protected by their cases; but also to the fact that insects which pass the winter in a torpid state are then less susceptible to injury than they are during the summer time, when they are active. Cut-worms of several kinds have been, as usual, complained of all over the country, from the North-west Territories down to the Alantic coast. Of the remedies suggested, the best results have been obtained from two which I have mentioned when before this Committee on a previous occasion, which consist of laying poisoned bundles of green food through the crop before and just after it is planted, and also of placing a strip of tin, or wrapping a small piece of paper, around the stems of plants liable to attack at the time of planting out.

An old enemy, the Pea-weevil, has developed in large numbers during the past two years. In the County of Prince Edward, so celebrated for the production of seed peas, it has increased very much, I am sorry to say. I have tested some of the old remedies in which reliance was placed, and found they were useless. Much of the work of the entomologist now is complicated by the fact that the popularity of this work has induced many to enter upon and undertake it who are not properly prepared to do so, and the consequence is that they write about many things they

have never tested for themselves, so that the newspapers are teeming with useless receipts.

MISCHIEVOUS QUACK REMEDIES.

Three-fourths of the newspaper entomology is inaccurate, and it does more harm than good, from the fact that so many people who read about these inaccurate and useless remedies try them and fail. Perhaps there is no remedy more written up in the newspapers than putting salt on fields attacked by Wire-worms, and from my own experience I can only say that it is utterly useless. A special study of Wire-worms has been made with great care during the past season at Cornell University by competent observers, and all the old remedies, many of which have been used and recommended over and over again, have been found utterly useless, and we must now say that we have not yet found any good remedy for Wire-worms, which attack the roots of plants, and particularly potatoes and grasses.

Breaking up in the fall such ground as is infested, when there is a time during which they are susceptible to injury from the disturbance or from atmospheric influences, has been found useful; and also poisoning the adult beetles which lay the eggs from which the Wire-worms are produced, by the use of poisoned potatoes or clover.

With regard to the Pea-weevil, I will mention some of these useless remedies.

In the first place, you will find it frequently said that infested pease, if thrown into water, will float and come to the top. This is not the case, as can easily be seen by any one who will try the experiment. It was also said that if infested pease were kept in a warm room during the winter all the Pea-weevils would come out, and would die before the time when the pease would require to be sown. This is a fallacy, too, for many of them are retarded in their development, and although it is true many of them do come out and die, there are still a sufficient number left, which come out later and destroy the value of the remedy.

With regard to the remedy of holding over seed, I have found that seed-pease held over for two years are just as good for seed as those only one year old. Three samples of tested seed gave 100, 99 and 99 per cent of vitality, so that we have a sure remedy in holding over until the second year any pease required for seed.* The best remedy for destroying Pea-weevils in the pease, on a large scale, is the bisulphide of carbon treatment. This is an extremely volatile and dangerous material. It is heavier than air, and when it is vaporized it is so much heavier than air that it can be poured out from one vessel into another, only that it is quite invisible, and if it is present, can only be told by a test. It is a dangerous and inflammable substance. If it comes into contact with flame, an explosion will take place. It must be used with great care, and can only be used to disinfect pease by those who possess proper apparatus. It is not applicable for ordinary farmers to use, but all the large seed-growers and seed merchants have close chambers where their pease are disinfected in this manner.

Last year, in the vicinity of Arnprior region, some 3,000 bushels of pease were imported from the United States to be used for seed in that district, because the Pea-weevil not occurring there naturally, the seed-pease grown there would be free from weevils, and therefore much more valuable than seed grown in most of the seed-growing districts of the United States. All insects have their metropolis or centre of greatest occurrence, and the Arnprior district is outside of the area where the Pea-weevil occurs naturally. Consequently, the seed-growers sent their seed to that district to be grown, in order that they might get clean seed. It is probable that the mature insects cannot endure intense cold, and there is, therefore, I think, very little danger of importing the Pea-weevil into that district to increase and remain there. Some of the perfect insects were sent to me last April, and I was asked if they were injurious, and if so, it was suggested that I should write to the

* Some seed of Black-eyed Marrowfats, 8 years old, grow well and produce a good crop.

local newspapers, giving an account of the insect, and advise as to the best course for the farmers to follow who had bought seed. Under the existing circumstances, the farmers having bought their seed, and got their land ready for sowing, destroying the weevils in the seed was the only practicable remedy.

A SUCCESSFUL REMEDY FOR PEA-WEEVIL.

The remedy used successfully was this: The pease were poured out into a large receptacle half filled with hot-water—wash-tubs were used generally; cold water, which had been got ready beforehand, was then thrown over them and the tub filled to the top. Directly the pease were thoroughly wetted the cold water was poured in, and they were then left to soak for 24 hours, and the beetles were all destroyed.

By Mr. McNeill:

Q. Did that hot water treatment injure the pease?—A. Not if they were only left in the hot water for a few seconds. The instructions required that the cold water should be all ready and standing by, and then poured in at once.

Q. How long would the pease be allowed to remain in the hot water?—A. They are poured right into the hot water from the sack, and then the tubs are filled at once with cold water and left for 24 hours. The pease can then be partially dried before sowing, so as to run easily through the spouts of the seed-drill. The inaccurate statement is frequently made that pease injured by the Pea-weevil are just as good for seed as those that are not. This was stated positively to me to be the case at a Farmers' Institute meeting by a farmer who professed to have tested the matter and reaped a heavy crop. His good crop, I believe, resulted from the fact that pease and many other crops are frequently sown too thickly, and that the plants which grew from the uninjured seed sown filled out and hid the deficiency of the weeviled seeds which did not germinate. It is contrary to reason that a pea, the substance of which has been diminished nearly one-half by an insect, should be as good for seed as if it were complete, and had the same amount of nourishment to feed the young plant as nature placed there originally.

RECIPE FOR PREPARING KEROSENE EMULSION.

By a Member:

Q. You spoke of kerosene emulsion. What are the proportions used in making it?—A. It is made by making a mechanical mixture of kerosene and soap-suds in the proportion of two of kerosene to one of soap-suds. These two materials are worked together with a force-pump for about five minutes, when a thick creamy batter is formed, and this can be reduced again to any weakness or state of dilution with cold water. Paris green is about the cheapest good remedy for insects where it can be applied; but it cannot be applied with all insects, and this kerosene emulsion covers all classes. Directly it touches the insect it spreads all over its body. Insects, as most people know, do not breathe through their mouths. They breathe through little pores which are situated along their sides, and any oily material, like kerosene, when it touches their bodies, suffocates them, by spreading over the body and stopping up the breathing pores. As to the exact proportions of soap-suds and coal oil, they are easily remembered, but I have always avoided, when possible, giving exact formulæ of remedies when speaking in public, because they are all published, and it is so easy to make a mistake in taking down a remedy given by word of mouth. I have given concisely, with full instructions for their application, all the more important remedies for insects in Bulletin No. 11 of the Experimental Farm series of the pamphlet, "Recommendations for the Prevention of Damage by some Common Insects of the Farm, the Orchard and the Garden." Some 25,000 have been distributed through the country, and it can be got by any one who applies for it.

The proportions are as follows:—One half of a pound of ordinary soap is dissolved by boiling in one gallon of water, and when it is boiling hot it is poured into two gallons of coal oil (kerosene), and churned with a syringe or a force pump, and in about five minutes it becomes thick and creamy; when this cools it consolidates into a jelly-like mass, which can be diluted with cold water. Kerosene emulsion has been found particularly useful during the past season for the treatment of one of the worst enemies we have in the orchard.

THE OYSTER-SHELL BARK-LOUSE.

This pest is injuriously abundant in every part of Canada, but owing to its inconspicuous appearance it is seldom noticed until it has completed its work of destruction and killed the tree. It attacks many kinds of trees and shrubs, but is particularly troublesome on apple trees and black currant bushes. I have also found it on mountain ash, birch and ash trees. At this time of the year it may be found on trees in the shape of a small elongated scale like a miniature oyster shell. This is really the dried up body of the female insect, beneath which will be found a large number of white eggs. In the month of May the young emerge from beneath the scales in countless numbers. They are minute creatures, hardly visible to the naked eye. They then climb up to the young wood, where the bark is tender, and through it they insert their little tube-like beaks, and never move again, but remain fixed by their beaks, sucking the sap out of the tree. They gradually secrete a waxy fluid, which covers and protects them. This covering resembles in appearance an oyster shell. There are probably more orchards killed and there is more loss to fruit from this one cause, than from all other causes put together. Farmers and fruit-growers frequently do not fight it, because they do not recognize it as an enemy that can do them harm. But if they do recognize it, and apply kerosene emulsion, they can destroy it as effectually as all other insects.

By Mr. McNeill :

Q. Do you wash the bark?—A. Yes; and the emulsion can be sprayed over the trees at the time the young are hatching, when all will be killed, When reducing the emulsion for this purpose, it can be diluted with nine times its volume of water.

Q. Would that be strong enough for these insects?—A. Yes, sir. A great many insects can be got rid of by using a mixture of even half this strength.

By Mr. Roome :

Q. Would it not injure the tree if put on too strong?—A. If it were put on stronger it might be injurious, but as a matter of fact you could not put it on much stronger without difficulty, for that is about the consistency you can use easily through a spray nozzle. Where the bark-lice are very numerous, the emulsion can be used early in the spring in the way of a wash or swab, to be put on either with a sponge, cloth or mop.

THE PEAR TREE SLUG.

The pear tree slug is another insect, which, during the past year, developed in injurious numbers. It is a slimy creature, that lives on cherry and pear leaves, and should be treated at once when observed with a weak Paris green spray of 1 lb. of the poison to 300 gallons of watter.

In the North-west Territories, during the past year, a native insect has occurred in very large and injurious numbers. It is a conspicuous red and black beetle, not quite so large as the Colorado potato beetle, which is found in this part of the country, but it feeds on plants of the cress family, such as turnips, radishes and cabbages. This did so much injury that I received in July and August some thirty or forty letters from settlers in the North-west. The insect was treated with Paris green successfully. It is called the Red Turnip Beetle.

A POPULAR FALLACY CORRECTED.

The subject of spraying with arsenites is one that has gained very much importance lately through the ridiculous and utterly absurd statements made throughout the world in newspapers. It was first stated by an obscure London horticultural journal—but when you read the articles you saw at once that the object was to get a little cheap advertising—that all American apples were saturated with arsenic. This statement was reproduced in many newspapers, and as the original paper which started the falsehood, in a later issue, gloated over the fact that these articles were copied all over the world, the paper thus showed its hand; it wanted to get cheap advertising. The statement is absurd that any apple or other living vegetable tissue can be saturated with arsenic, from the fact that the poison is so exceedingly corrosive that before any vegetable tissue could become saturated, even if this were possible, it would be destroyed before the poison could penetrate. The only suggestion of truth in regard to this statement is that we do spray our orchards with Paris green, which is an aceto-arsenite of copper. But that is not arsenic. It is an arsenical compound containing about 45 per cent of arsenic; but it must be remembered that this is not the same by any means as arsenic, which is soluble, while Paris green is almost insoluble; so it is not at all like putting on our trees a mixture containing 45 per cent of soluble arsenic. It is only an insoluble compound which, by the special treatment recommended, never can and never does get into the fruit. Then, besides this, it is applied at the small rate of 1 lb. to 200 gallons or more of water. This quantity of water is sufficient to spray a great many trees—a tree of the ordinary size takes from one to three gallons—and these trees bear many hundreds of apples, and thousands of leaves so that there would be only a very minute quantity of poison on each fruit Even supposing soluble arsenic were used and every apple were covered with it, none could get into the apples. At the time apple trees are sprayed the fruit is very small, indeed, hardly formed, and is then protected from anything falling on it by a thick covering of down and the spreading lobes of the calyx. In spraying, the liquid is applied as a very fine mist; most of this falls on the foliage; but some—a minute quantity—falls into the open calyx, where the eggs of the codling moth are laid. It is an infinitesimal quantity, yet is sufficient to destroy the insect if it be there, as frequent experiments have shown us. I cannot imagine anything more absurd, however, than the idea that there could be any arsenic in apples, which had been sprayed, as soon as the flowers had dropped, with Paris green. In the first place, the quantity of poison is so small it is practically insoluble, and above all, it is not at all adhesive, so that directly the small amount of moisture in it which is sprayed on to the trees has evaporated it is a dry powder. Even supposing you put it on as thickly as you could all over the fruit, the natural expansion of the apple in growth would disseminate it and force it off the surface; the frequent rains we get during the summer, and the frequent winds, all help to remove it, and we know that it is entirely gone, as proved by experiment, long before the harvesting of the fruit takes place. Yet these articles appeared, and our own papers copied them and commented upon them. Now, this is where the injury comes in; spraying with arsenites is the remedy we have been trying for years to persuade farmers to adopt in order to protect themselves against a great and unnecessary loss. I claim by the application of this one remedy for the apple worm, that a saving of at least 75 per cent can be made in the quantity and quality of the fruit. Such articles raise a doubt as to the advisability of using what is a good and safe remedy. We are told: "Paris green is poison, and therefore is dangerous." Of course it is poison, otherwise it would not do the work we use it for; but the statement as to the danger of poison getting into the apples is absurd, because impossible. The quantity used is so small that the elements to which it is exposed would destroy or remove it long before it could penetrate a growing apple. Through the kindness of Mr. Woolverton, the editor of *The Canadian Horticulturist*, I procured some apples that had been sprayed twice, and had them analysed most carefully by the Chemist of the Farm, who took very

great care to analyse them all by a process by which, if there had been even one fifty-thousandth part of a grain of arsenic in them, it could have been detected. He found there was not a trace of arsenic. Yet these people write such nonsense and spread it all over the world, and some foolish people, without taking the trouble to think, believe them.

If we did not know the reason why this was done it would be inexplicable, but we do. We know to-day that our Canadian apples are better than any apples in the market. We know that Americans come here and buy them because they are much better than theirs. To show that conclusively, you have only to go to a horticultural exhibition in the United States, or to see the difference most plainly, go to the Pacific coast. Buy apples in San Francisco and go up the coast, through the Pacific States, and you will know with your eyes shut which apples are best. They improve perceptibly in both colour and taste as you go north. It is due to the climate that fruit grown in the south is not as good as our northern-grown fruit. Our apples are better than any others, and are taking the first place in the market. They are fetching a higher price in England than the native apples, or any that can be imported. Our apples, too, are perfectly safe as food. They have been tested by a chemical analysis that cannot fail, and this analysis is backed up by the common sense of any one who examines the matter. Many analyses have been done with care, and show there is not the slightest danger in the use of Paris green, as directed by entomologists. It is important for all to know this and understand why it is so, when people say they won't use Paris green, because they injure the crop. That is all nonsense. The only injury spraying could do would be by destroying the leaves, if it were used too strong. If the leaves of a tree are destroyed, it cannot produce any fruit. I occasionally meet people still, even in Canada, who say they do not put Paris green on their potatoes, because it may injure the tubers. There is no fear, whatever, of Paris green getting into the tubers, for those are merely receptacles for storing up starch for a special purpose, and are not roots, but enlarged buds at the extremities of underground stems. Their contents are manufactured by the plant from gases taken in through the leaves from the atmosphere and from water taken up by the roots. Thus, the starch in the tubers is a compound material, an important part of which must come from the air through the leaves, and the tubers, not being roots, take up themselves nothing from the soil, but are merely receptacles, as just explained, for the preservation of a special product, which is to insure the perpetuation of the plant over the winter.

Again, the form that this arsenic absorption scare took some years ago was that the poison could be absorbed by the pistils of flowers upon trees which had been sprayed. This was equally absurd with the present contention, for not only are trees sprayed after the petals have fallen and when the pistils have performed their office, and in most cases dried up, but even if they were sprayed with Paris green while the flowers were in blossom and their essential parts in their prime, it must be remembered that the stigma of a flower is without any epidermis, and is, therefore, exceedingly delicate, so that any corrosive poison like arsenic, in even a very weak solution, would be much more likely to injure the stigma than to be absorbed; and further than this: even in the natural operation of fertilization, the stigma is a passive organ, and absorbs nothing. The activity is on the part of the pollen, which pushes out its fovilla-bearing tubes and protrudes them through the tissues of the stigma down into the ovary. This susceptibility of the pistil to injury has been taken advantage of in the State of New York in the treatment of a local but very injurious insect.

THE APPLE MAGGOT.

It was deemed necessary to resort to the extreme measure of destroying the whole crop of fruit so as to reduce by that amount the food supply of the insect for a year, and it was suggested that this could easiest be done by spraying some corrosive material over the trees while in blossom. This remedy, however, leads us to a difficulty which has lately been considered by the Ontario Government. Apiarists

claim that fruit-growers have been spraying their trees whilst in bossom and that their bees have been poisoned by gathering the poisoned nectar. Of course the practice of spraying trees while in blossom is quite wrong, and should be stopped with a firm hand for all considerations. The horticulturist is liable to injure his fruit directly, and if it be true that the bees are poisoned, he not only injures the bee-keepers, but also destroys his best friends. Bees are known to perform such an important part in the fertilization of many flowers that advanced fruit-growers keep bees in their orchards for that very purpose. We all know that the quantity of blossom on fruit trees in the spring cannot be taken as an index of the quantity of the crop that will be reaped, unless there be at that time sunny weather, so that the bees and other insects may visit the flowers and fertilize them. Botanists have discovered that it is far more advantageous for flowers of a plant to be fertilized by pollen taken from other flowers, and this is carried so far that nature herself provides, in many flowers, means by which fertilization by their own pollen is impossible. In some plants we find separate male and female flowers; these may be either on different plants altogether or upon different branches of the same plant, Again, in cases where the flowers are perfect, and contain both male and female organs, we find that these may mature at different times, so that when the female organ, the pistil, is ready to receive the fertilizing pollen, the anthers of its own flower may have already shed their pollen, or *vice versa*. Charles Darwin, the great physiologist, summed up his observations on this subject in the trite generalization that "nature abhors self-fertilization."

Although in some cases self-fertilization may be possible, it is not so in all, and it is probably better in all plants that the pistil be fertilized by pollen from other plants. Now, with regard to bees being poisoned by gathering honey from flowers which have been sprayed with Paris green: although I do not know of any actual experiments having been tried, from what I have lately read on the matter, I think that it is quite possible that they can be poisoned, and if so, we may just as well recognize it at once. Sometimes enthusiasts go too far—some saying that it cannot be done, whilst others say it can. What we want, however, are facts ascertained by careful observations. Bee-keepers claim that they know of actual instances, when bee-hives have been located near orchards which have been sprayed during the time that the trees were in flower, and that the bees have been found poisoned. A writer in a late number of the *American Bee Journal* claimed that the Paris green could be plainly seen in the bees' bodies. This last statement, however, I think must surely have been an exaggeration, although it is probably the case that they may have been poisoned either by the nectar or by drinking water from the sprayed leaves. It was also claimed that the honey stored away in the comb was poisonous; but this last statement will require far more proof than has as yet been brought forward.

Honey, as it occurs in the comb, is an altogether different thing from the nectar of flowers. Before it becomes honey it has to be partially digested by bees, and is not honey at all when in the flowers. The bees suck up the nectar and elaborate it into honey. I am under the impression that before they could turn poisoned nectar into honey they would be killed by the poison. Another safeguard is this: at the time fruit trees are in flower, although the bees might be poisoned, if some careless fruit-grower were to spray at that time, it would be very unlikely that poison would get into the honey we eat. The honey stored away in the honeycomb is only the surplus. At the time when spraying is done, early in the season, bee-keepers tell me that the bees used the honey they collect then almost entirely as food for their brood, and the honey we steal from them afterwards is only the food which they have laid up for themselves for use during the winter; or, in other words, there is no surplus honey, apiarists say, at the time of the year when fruit trees are in flower. I believe that bees have been found, and Prof. Cook, of Michigan, a high authority on bees, states that larvæ have been found poisoned through partaking of this poisonous food. This is the whole thing, and the question came up for discussion the other day before a committee of the Ontario Legislature, when I was asked by the provincial Minister of Agriculture to go to Toronto and give evidence before the committee. The question that was put to me

was this: "Is there any practical or scientific reason why this Act to prevent the spraying of trees while in blossom should not pass?" I could not think of any reasonable objection; for, spraying when the trees are in flower is quite unnecessary and is very unadvisable; because, if, as apiarists claim, their bees are poisoned if Paris green be applied when the trees are in bloom, and I maintain you may do more harm than good by destroying the pistils of the flowers. Why do bees visit flowers? To get honey, and nature provides this so as to attract insects at the time when they can be of most use in fertilizing the flowers. Directly the pistil is fertilized, no more honey is developed; it is no more use to the plants. If we wait for spraying until the flowers drop off, there is no danger of poisoning the bees, because they do not then visit the trees. There is nothing to take them there; but by spraying the trees after the flowers drop, we do destroy the little caterpillar which hatches from an egg laid by the codling moth in the calyx, and the small quantity of Paris green which we recommend—one pound in two hundred gallons of water—is sufficient to kill the larvæ, and as a consequence we get a return for our labour in 75 per cent more fruit than we should otherwise have had.

By the Chairman:

Q. You must put that on by spraying?—A. Yes.

By Mr. McNeill:

Q. What quantity of that poison destroys human life?—A. I think two and a half grains of arsenic is a fatal dose, and Paris green contains about 45 per cent of arsenic in chemical combination.

Q. How much of that mixture would it require to poison a man?—A. Well a pound of Paris green in 200 gallons of water is the strongest we ever use. I suppose a cupful might make a man feel uncomfortable.

Q. The particle that would fall upon the fruit would have on a person no effect whatever?—A. No. I would not at all mind eating fruit which had been sprayed. Think of the small size of the apple at the time; it is only just forming, and it is raised up in such a way that the calyx would cover the whole fruit, and most of the spray would fall inside the calyx. The egg does not hatch for a week or so after the flower drops off. The moth flies to a flower directly it has opened, and lays a little egg inside it. In time the egg hatches, but not for a week or ten days. At the provincial committee at Toronto there was some discussion on the effects of spraying for the Plum Curculio; but this insect is not at all attracted to the plum trees by the nectar of the flowers. It lays its eggs just beneath the surface of the plum when the latter is about as big as a large pea.

FUNGOUS DISEASES OF PLANTS.

Allow me now, Sir, to turn to another part of my work: the study and treatment of the diseases of plants due to the attacks of parasitic fungi. During the last four or five years most satisfactory results have been secured by cryptogamic botanists in the treatment of these plant diseases. Remedies have been discovered by which some of the most destructive of these may be controlled with comparative ease. The black spot of the apple, the mildew of the grape, and particularly the rot or blight of the potato, are notable instances where a large amount may be saved by preventive treatment.

POTATO ROT AND ITS REMEDY.

The last named of these diseases, the potato rot, causes a great diminution of the crop every year throughout the length and breadth of Canada—perhaps, year in and year out, 50 per cent of the whole crop grown. The life history of the fungus which causes this disease has been worked out and is well understood. It passes the winter inside the potato tuber. When growth begins in spring it germinates, and throws out its vegetative system, and creeps up through the tissues of the potato

stem, and during July and August manifests itself as a white frosty growth or mildew on the potato tops; this is followed by the leaves turning brown in spots, and giving the appearance known as potato rust. At this time spores or seed-like bodies are formed, which drop from the potato tops to the soil beneath and are washed by rain down to the forming tubers below the surface; here they germinate, and penetrate the tissues and eventually destroy the potato. Now, if one of the known fungicidal mixtures be sprayed over the potato tops as they grow in the field, beginning at the time the white frosty appearance first shows itself, the spores will be destroyed and the crop saved.

The spraying will require to be repeated at least twice. The mixture which has given the best results is the Bordeaux mixture. This is made as follows: Dissolve 6 pounds of copper sulphate in 10 gallons of water; throw this into a barrel which will hold 45 gallons. In another tub slake 4 pounds of perfectly fresh lime in 6 gallons of water. When all the lime is slaked pour it slowly through a strainer into the copper solution; a coarse gunny sack tied over the head of the barrel answers well for this purpose. Afterwards fill the barrel up to the top with water, which will make 45 gallons; stir thoroughly, and all is ready for use. It is best to use powdered copper sulphate, and the lime must be quite fresh.

Made as above, the mixture costs about one cent a gallon, and a barrel will be sufficient to spray a very large area. This last point of course will be regulated by the kind of nozzle used.

I regret to say that so far, although the efficacy of this remedy has been thoroughly proved, very few of our Canadian farmers have been persuaded to try it. It is a new remedy, and they seem to prefer old methods, with their attendant dangers, to trying anything new, no matter how great the advantage may be. What makes this remedy particularly convenient is that it may be used at the same time and with the one application as Paris green, which all good farmers now know that they must use to protect their potato crop from the Colorado potato beetle; one-fourth of Paris green in the above quantity is sufficient. I am in hopes, however, during the ensuing season, to carry out some experiments which will prove conclusively the great advantage of this easy and cheap remedy.

As the potato blight does not occur every year, if careful watch were kept, so as to detect the first appearance of the mildew upon the leaves, probably the cheapest way to treat potatoes would be not to apply the fungicidal mixture until the disease showed itself: and then at once, as soon as its noticed, the potatoes should be sprayed. Prof. Jones, of Vermont, records, a successful experience on this line, by which a large proportion of a crop was saved by a single spraying, while the product of two contiguous plots that were not treated was badly diseased.

By Mr. McNeill:

Q. How is it u d?—A. By spraying. In applying this it is best to use proper spraying apparatus, and particularly a good nozzle. Thus the work is done much more thoroughly and also more easily. We have two different kinds of spraying pumps on the Experimental Farm. One is a knapsack sprayer, which holds about four gallons, and is carried on the back. This I found a very useful and convenient instrument.

By Mr. Roome:

Q. Do I understand these spores attack the tubers when growing?—A. In July and August spores are produced on the diseased tops, and, some time after they fall, get into the ground, and produce the same disease, manifested in a different form, viz., the rot of the tuber. Although spoken of, and usually seen as a wet putrescent decay of the tuber, as a matter of fact potato rot is really a dry rot. The wet rotten condition is simply the decaying of dead tissue, and a similar condition is produced when potatoes are killed by freezing; when attacked by the dry rot the life of the potato is destroyed and it then decays.

Q. The disease must be owing to some kind of poison in the tuber. Supposing you remove the tops altogether?—A. That is done when the disease developes late in the season, but if done early the potatoes would not form. When the top is injured the tubers are not produced.

Q. Does it strike the tuber itself?—A. Yes, the spores first from on the tops, and then, being washed into the soil, attack the forming potatoes.

By Senator Perley :

Q. How does it get into potatoes in the cellar?—A. The dry rot was in the potatoes when carted from the field; some of them, however, might not show any disease until you cut them.

By Mr. Roome :

Q. I suppose the disease matures there?—A. Yes. It either keeps growing and throwing out its branches through the tissues, when the tuber rots, or it lies dormant until the next year as a dry rot.

By Mr. Rosamond :

Q. Where can you get these spray pumps?—A. You can import them from the United States. I can give you several addresses. I am afraid I do not know of a Canadian maker yet. There was a maker, I believe, at Picton, and another at Leamington, but I have not seen their pumps. There are several makers in the United States.

By Mr. McNeill :

Q. You often find potatoes put away that appear quite sound, but are not sound?—A. Yes, the disease is hidden inside the potato. Directly the spore reaches the growing tuber it germinates, and shoots out microscopical tubes, which penetrate the tissues.

Q. I understand the best way to treat this is to have a man going through the field with a knapsack sprayer?—A. Yes, a man can walk quickly and keep the spray going all the time.

By Senator Perley :

Q. How many rows at a time?—A. That will largely depend upon the wind. Last spring I sprayed three acres of pease walking through them as fast as I could. I was able to spray a strip 20 feet in breadth because of a gentle breeze blowing at the time. There was an attack of a kind of marching cut-worm. They appeared in great numbers, and swept three and a-half acres of our pease before the attack was noticed. Directly it was observed, I had a field sprayed with a very strong mixture of Paris green and water. We stopped the cut-worms at the line where they were when the spraying was done, and the pease grew up again and bore just as heavy a crop as those which had not been eaten off. The mildew of the grape may be very satisfactorily treated with the carbonate of copper mixture, recommended by Mr. John Craig, our Horticulturist, in his Bulletin 10. Mr. John Lowe, Deputy Minister of Agriculture, has a vineyard with several hundreds of vines. Last year he probably lost half of his grapes, many hundred weight. This year he did not lose 20 pounds, a saving which I attribute entirely to two careful applications of the carbonate of copper treatment.

CULTIVATION OF FODDER GRASSES ADAPTABLE TO CANADA.

Before closing, I should like just to refer to another subject upon which I have been engaged, and which I brought before you last year: the cultivation of fodder grasses. We find from experiment that many permanent pasture mixtures which are offered for sale contain grasses not suitable to this climate. We have in this country a great many grasses suitable for cultivation which would produce valuable fodder plants and which can be grown successfully; they are being grown and care-

fully tested on the Experimental Farms. A small distribution is now being made of seeds of some of the more promising of these varieties. They are being sent to such farmers as have asked for them. I have now perhaps 180 or 200 English names on my list. I want to get another 20 or 30 English and another 50 or so French, and these will be attended to in the order in which the applications are received, until the supply to be distributed is exhausted. If any members present know farmers who would like to try these new grasses, I shall be glad to get their names. I am only sending out small packages, containing seed enough to sow a single drill 20 feet in length. This will give the growers a small quantity of seed, and will also show what grasses will succeed in the different districts. Instructions are sent with each package, and I believe it will be an experiment of great value to the country.

GRASSES UNSUITABLE IN CANADA.

I might mention the names of some grasses which have proved unreliable and not suitable for this district. Some of these are sold at high prices. Sweet Verral grass is advertised at $9 a bushel. It is of no value here.

The Italian Rye-grass and the Perennial Rye-grass are utterly useless, and yet they make probably 50 per cent of all seed mixture sold in this country.

By Mr. McGregor :

Q. Are they not good in western Ontario?—A. In western Ontario the Perennial Rye-grass does in some districts, but not in all. I do not think that in Canada it will do as well as some other grasses. In Scotland it is the favourite grass, and produces enormous crops. One of the chief causes of complaint from purchasers of grass seeds is that they are used on their English or European reputation, because no one has tried them in this country. Our seedsmen do not grow them themselves, but they take the character given them by European seedsmen. They do not take into consideration the fact that they are to be grown in an entirely different climate.

I will not delay the Committee any longer, Mr. Chairman, but will finish by asking the members present to do me the favour of applying to me or letting me know at any time when crops in their neighbourhood are attacked by insects or fungi.

By Mr. McNeill :

Q. At what time do you spray grapes?—A. Grapes should be sprayed first when the leaves are about an inch and a half in diameter, before the flowers are open, and twice afterwards at intervals of three weeks.

Having read the preceding transcript of my evidence, I find it correct.

JAMES FLETCHER,

Entomologist and Botanist, Dominion Experimental Farms.